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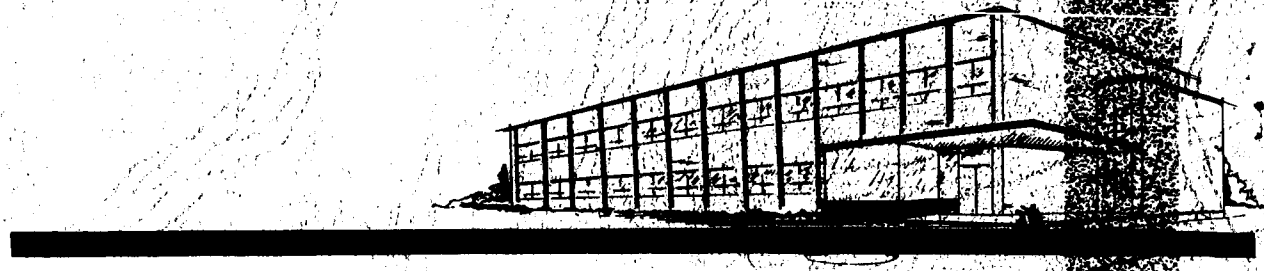

THE Bendix CORPORATION

BENDIX SYSTEMS DIVISION · ANN ARBOR MICHIGAN

LUNAR SURFACE MOBILITY SYSTEMS COMPARISON AND EVOLUTION STUDY (MOBEV)

Monthly Progress Letter

September 1966

BSR-1430

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SECTION 1

INTRODUCTION AND SUMMARY

This is the eighth monthly progress report submitted under Contract NAS8-20334 for "Lunar Surface Mobility Systems Comparison and Evolution Study". It covers the period from 1 September, 1966 through 30 September, 1966.

The primary effort during this period was centered on the following tasks:

(1) Finalization of Methodology development.

(2) Coding and debugging of Methodology.

(3) Completion of new conceptual design and Task 3 vehicle modification for Task 5 Design Point Vehicles.

(4) Documentation of Rover and Flyer Design Point Vehicles for the MOBEV DPV Data Book.

(5) Finalization of Resources Data for the DPV's and for the Methodology.

(6) Documentation of Resources Data for the Data Book.

(7) Preparation and delivery of the Second Interim Presentation held at Bendix on September 15th. Program status and major technical aspects of the study through August 31st were covered during the presentation and are included in the brochure report, BSR-1369.

SECTION 2

SCHEDULE STATUS

The present MOBEV schedule is shown as Figure 2-1. The solid bars identify the work completed; the broken bars identify the scheduled future effort.

The Phase II efforts are complete with the exception of the Data Book documentation and development of comparison data. The Roving and Flying vehicles are being documented in the final format for Book 1 of the Data Book. Comparison data is being assembled for Book 2 of the Data Book.

Development of the Methodology has been finalized. The remaining effort involves programming and debugging of the updated computer logic and DPV technical and resources data. Validation of the Methodology is scheduled to be completed by the end of October.

The final report will be completed in draft form for transmittal to NASA for review by the end of October.

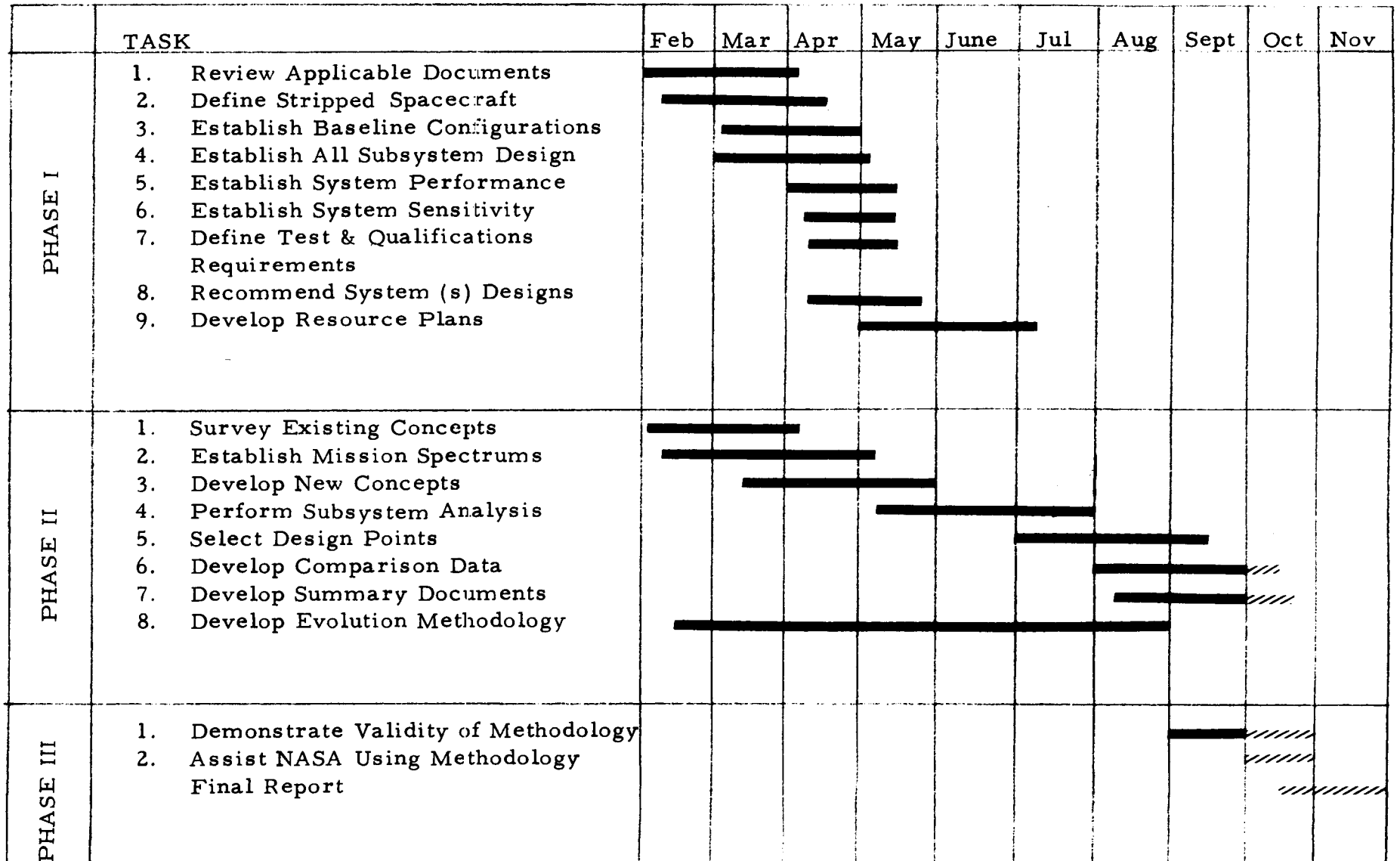

Figure 2-1 Revised MOBEV Schedule

SECTION 3

WORK ACCOMPLISHED

3.1 LUNAR ROVING VEHICLE SYSTEMS

During this reporting period the conceptual design of all Design Point Vehicles (DPV's) was completed, and documentation for the DPV Data Book and final reports was started.

3.1.1 LRV Design Point Vehicles

Agreement on the final selection of DPV's was reached at the end of August. The resulting spectrum of vehicles was presented as part of the MOBEV Second Interim Presentation on September 15th. The spectrum as contained in the presentation brochure, BSR-1369, is shown on Table 3-1 for reference.

3.1.2 Systems Engineering

Efforts during September centered on completion of designs and the documentation of the Task 5 vehicle concepts for the Design Point Vehicle Data Book (Task 7, Part 1). New designs specified in Task 5 include the One-Man 48-hour sortie exploration vehicle (R-1-D-E); the One-Man Pack Mule/Go-Cart vehicle (R-1-A(1)-E); the Three-Man MOLAB (R-3-C-E); and the Three-Man 90-day exploration vehicle (R-3-D-E).

Modifications to existing Task 3 concepts were also specified to increase vehicle/mission capability in terms of mission duration, scientific performance, range, and speed. The SLRV (R-0-A-E) power supply was changed from solar cells to an RTG and the delivered mass allowed to increase to 68 kg. This enabled the vehicle to be designed for night survivability, with an accompanying increase in mission duration (90 days), and range (75 km). The RTG also provides additional power for scientific tasks.

TABLE 3-1

FINAL DESIGN POINT VEHICLE SPECTRUM

Designation		Range (km)	Mission Duration (days)	Payload (kg)
PRIMARY DPV'S				
R-0-C-E	Remote Unmanned Traverser (RUNT)	200	90	50
R-1-A(1)-E	Greater Versatility Go-Cart	144	14	75
R-1-B-E	Baseline LSSM	360	14	320
R-1-B(1)-E	Greater Versatility LSSM	360	14	320
R-1-D-E	Cabined LSSM	500	14	320
R-2-C(1)-E	14d MOLAB (Bendix)	400	14	320
R-3-B-E	42d MOBEX	1600	42	1500
R-3-D-E	90d MOBEX	3425	90	1500
R-1-C-B	Lunar Tractor	15/day	730	2316
SECONDARY DPV'S				
R-0-A-E	SLRV (RTG)	36	90	4
R-0-B-E	Pack Mule	36	14	75
R-1-A-E	Go-Cart	240	14	10
R-3-A-E	28d MOBEX	800	28	700
R-3-C-E	3-Man MOLAB	400	14	320
R-0-A-B	Greater Versatility LSSM Trailer	N/A	N/A	969
R-0-B-B	MOLAB Trailer	N/A	N/A	2768
R-0-C-B	MOBEX Trailer	N/A	N/A	6302
R-1-A-B	Greater Versatility LSSM Prime Mover	35*	730	320
R-1-B-B	Cabined LSSM Prime Mover	500*	730	320
R-2-B-B	14d MOLAB Prime Mover	400*	730	320

*Single sortie range

The original LSSM has been divided into a baseline LSSM, battery powered and with no astrionics; and a greater versatility LSSM with complete communication and navigation capabilities, and an RTG power source. The RTG allows unmanned remote-controlled operation (similar to that of the original R-0-D-E concept) prior to or following the manned mission. The vehicle can also be used as a two-man LSSM with some degradation in performance.

3.2 LUNAR FLYING VEHICLE SYSTEMS

Lunar Flying Vehicle efforts during September included: (1) preparation for the Second Interim Presentation, (2) documentation of all flying vehicles to the Data Book format, (3) preparation of final resources data.

Analysis of refueling, propellant variations, propulsion commonality, and guidance and navigation areas have been completed and documented. The results of these studies are being incorporated where applicable in the Flyer DPV designs. Efforts on documentation of all flyers to the final format for technical and resources data are in the final stages, and are scheduled for completion in draft form in October.

3.3 METHODOLOGY DEVELOPMENT AND VALIDATION

During this reporting period the Methodology Logic has been finalized, the input questionnaire revised, and some changes in the program capacity made.

Coding and debugging are in the final stages and plans are being made for putting the Methodology on the NASA 7094.

3.3.1 Logic

Some changes have been made to the logic. These changes supersede the preliminary set of logic diagrams distributed at the Second Interim Presentation.

Most notable of these changes are:

(1) The addition of a PLSS test and mass penalty as a function of sortie duration for vehicles without cabin.

(2) Addition of an EVA mass penalty computation for vehicles with cabin. This penalty is being tied to airlock cycles. For one and two-man vehicles the mass penalty of one PLSS recharge will be assessed, in addition to the normal gas loss penalty, for each cycle of the airlock. For three-man vehicles 1.5 PLSS recharge masses will be assessed per airlock cycle.

(3) A mass check has been added to cover the situation where one vehicle is transported by another (such as a rescue flyer carried along by a rover on its mission). The nature of this test is similar to the one employed where two or more mobility systems are landed by the same delivery system. In these cases, after vehicles have been selected for each mission and a vehicle set generated, subset mass checks are required to assure validity of the set generated.

3.3.2 Input Questionnaire

The input questionnaire has been revised to reflect the logic changes and additions, and also to reduce the number of pages the planner has to work with. This has been achieved by providing a separate answer sheet rather than having the planner mark his inputs directly on the questionnaire. In this manner the questionnaire is reusable and need only include one copy of each input sheet (formerly the questionnaire included multiple copies of some sheets due to the multiplicity of missions).

3.3.3 Program Capacity

The number of missions which the program is able to accommodate has been increased from fifteen to twenty.

3.4 RESOURCES PLANNING

During September all resources data was finalized.

(1) Prior development cost saving matrices for all DPV (Exploration, Base Support, and Flyers) were completed and supplied as inputs to the Methodology.

(2) The Phase I Resources Plan volume has been completed in draft form.

(3) The Resources Plan Final Report, Volume II, Book 5 has been started and is scheduled for completion in October.

(4) The resources data for the Data Books, Parts 1 and 2 is 80% complete for all DPV vehicles and will be completed early in October.

SECTION 4

BIBLIOGRAPHY

4.1 MOBEV STUDY MEMORANDUMS

Following is a selected list of the MOBEV Study documents prepared during the month of September. (Copies of Bendix team generated data may be obtained through Mr. R. C. Glasson, Bendix Huntsville Representative.)

1. MOBEV Navigation Systems, D. Breseke, 6 September (MOBEV-342).

2. Phase II, Task 5-Communication Systems Definitions, G. Johnston, 8 September (MOBEV-344).

3. MOBEV Methodology, C. Muscolino, 12 September (MOBEV-346).

4. MOBEV Vehicle Specific Energy Parametric Data, R. Keely, 28 September (MOBEV-349A).

5. Task 7 Reliability and Crew Safety Analysis, A. Rousseau, 27 September (MOBEV-356).

6. Correlation of Bendix and Bell Vehicle Cost Breakdown and Tabulation of Learning Curves from 91 to 95%, C. E. Satterlee, Bell Aerosystems, 9 September (MOBEV Log No. 127).

7. MOBEV Flying Vehicle Cost Matrix and Prior Development Savings Matrices for Inputs to the MOBEV Methodology, C. E. Satterlee, Bell Aerosystems, 20 September (MOBEV Log No. 128).

8. Final Resources Data for MOBEV Flying Vehicles, C. E. Satterlee, Bell Aerosystems, 28 September (MOBEV Log No. 131).